

REMARKS

A. Background

Claims 50, 51, 53-60, 77-82 and 84-98 were pending in the application at the time of the Office Action. Claims 50, 51, 53-60, 77-82 and 84-98 were rejected as being obvious over cited art. By this response applicant has cancelled claims 54, 57-60, 79, 84, 90-95, 97, and 98; amended claims 50, 56, 81, and 96. As such, claims 50, 51, 53, 55, 56, 77, 78, 80-82, 85-89, and 96 are presented for the Examiner's consideration in light of the following remarks.

B. Proposed Claim Amendments

Applicant has herein amended claims 50, 56, 81, and 96 to further clarify, more clearly define, and/or broaden the claimed inventions to expedite receiving a notice of allowance. For example, independent claims 50 and 81 have been amended to clarify that the n-type emitter layer and the indium-containing p-type nitride semiconductor layer are formed on separate portions of the top surface of the p-type base layer. Claims 50 and 81 have also been amended to respectively incorporate the limitations of claims 54 and 84, which previously depended from claims 50 and 81.

The amendments to the claims are supported in the application at least by pending claim language and by Figures 1 and 3 and the corresponding discussion in the specification. In view of the foregoing discussion, applicant submits that the amendments to the claims do not introduce new matter and entry thereof is respectfully requested.

C. Rejections based on 35 USC § 103

Pages 2-8 of the Office Action reject claims 50, 51, 53, 55, 56, 58, 77-82 and 85-89 under 35 USC § 103(a) as being unpatentable over U.S. Publication No. 2002/0195619 to Makimoto et al.

(“*Makimoto*”) in view of U.S. Patent No. 6,313,488 to Bakowski et al. (“*Bakowski*”). Inasmuch as claims 58 and 79 have been canceled herein, the rejection of those claims has been rendered moot and should be withdrawn. Regarding claims 50, 51, 53, 55, 56, 77, 78, 80-82 and 85-89, Applicant respectfully traverses this rejection and submits that a *prima facie* case of obviousness has not been established. Of the rejected claims, claims 50 and 81 are independent claims.

In the rejection of claim 50, the Office Action alleges that *Makimoto* discloses the claimed inventions, but concedes that *Makimoto* fails to teach an indium-containing p-type nitride semiconductor layer formed directly on the p-type base layer, such that the semiconductor layer does not contact the n-type emitter layer, and a base electrode formed over the semiconductor layer. The Office Action then cites to *Bakowski* to attempt to remedy this deficiency of *Makimoto*.

As shown in Figure 1, *Bakowski* is directed to a bipolar transistor having three electrodes 1, 3, and 5 that respectively make contact with an emitter 2, a collector 4, and a base 6. *Bakowski* discloses that the base 6 has a doping concentration of about 10^{14} cm^{-3} . See col. 4, lines 51-54 and 62-64. Figure 3, which is cited by the Office Action, shows an embodiment where “a sub-layer 11 of the base layer 6 ... [has] a higher p-type doping concentration than the rest of the base layer,” the higher concentration being “one or two orders of magnitude higher.” Col. 5, lines 34-38. *Bakowski* discloses that the reason for this is to introduce “an energy barrier for the electrons” that will divert the electrons away from the contact electrode 5 positioned above the sub-layer 11. Col. 5, lines 39-44.

As noted above, *Bakowski* discloses that the energy barrier is “a sub-layer 11 of the base layer 6,” doped so as to have a higher concentration of dopant. That is, sub-layer 11 is not a separate layer positioned on the surface of the base layer 6, but simply an internal region of the base layer 6 having a

different doping concentration. In other words, base layer 6 includes sub-layer 11. Thus, even with sub-layer 11, the electrode 5 of *Bakowski* is still disposed directly on base layer 6.

In light of the above, Applicant submits that even assuming, *arguendo*, that it would have been obvious to modify *Makimoto* based on Figure 3 of *Bakowski*, the combination would at most teach a base layer that had an internal region that had a different doping concentration.

As an alternative to sub-layer 11, *Bakowski* teaches, in Figure 4, a separate layer 12 that is also meant to be an energy barrier for the electrons. See col. 5, lines 45-53. To be able to act as an energy barrier, *Bakowski* discloses the separate layer “having a wider bandgap than ... the base layer.” Col. 5, lines 48-49. Applicant notes that as known in the art, the bandgap of InGaN becomes smaller as the In composition increases. Thus, to form the separate layer 12 of *Bakowski* out of InGaN to be an energy barrier (i.e., so that the separate layer 12 had a wider bandgap than the base layer 6) would require the In concentration to have a mole fraction less than the base layer.

In view of the foregoing, Applicant submits that even if combined in the allegedly obvious manner set forth in the Office Action, the allegedly obvious combination would not teach or suggest all of the limitations recited in the rejected claims. Specifically, the combination would not include “an indium-containing p-type nitride semiconductor layer **formed directly on a second portion of said top surface of said p-type base layer** ... [wherein] said indium-containing p-type nitride semiconductor layer **has an indium mole fraction that is higher than an indium mole fraction of said p-type InGaN base layer**, and does not contact said n-type emitter layer,” as recited in amended claims 50 and 81.

Furthermore, Applicant submits that it would not be obvious to modify *Makimoto* to have an indium-containing p-type nitride semiconductor layer in which the indium mole fraction is higher than in the base layer. In contrast with the cited portions of *Bakowski*, which are attempting to provide an

energy barrier element for the electrons, the main object of *Makimoto* is to provide better ohmic contacts (i.e., lower the resistance). See *Makimoto* Abstract. That is, the objective of *Makimoto* is to enhance the energy flow to the contacts, not prevent it. However, as noted above, if the indium mole fraction of a semiconductor layer formed on the base layer is higher than the indium mole fraction of the base layer, then the ohmic contact would get worse, as the energy barrier would increase. This would effectively render *Makimoto* unsatisfactory for its intended purpose.

In light of the above, Applicant submits that a *prima facie* case of obviousness has not been established regarding claims 50 and 81, at least because the allegedly obvious modifications would render the primary reference unsatisfactory for its intended purpose and because the allegedly obvious combination would not include all of the limitations recited in the rejected claims. Accordingly, Applicant respectfully requests that the obviousness rejection with respect to claims 50 and 81 be withdrawn.

Claims 51, 53, 55, 56, 77, 78, 80, 82 and 85-89 each depend from claim 50 or claim 81 and thus incorporate the limitations thereof. As such, applicant submits that claims 51, 53, 55, 56, 77, 78, 80, 82 and 85-89 are distinguished over the cited art for at least the same reasons as discussed above with regard to claims 50 and 81. Accordingly, Applicant respectfully requests that the obviousness rejection with respect to claims 51, 53, 55, 56, 77, 78, 80, 82 and 85-89 also be withdrawn.

Pages 9-12 of the Office Action reject claims 54, 57, 59, 60 and 84 under 35 USC § 103(a) as being unpatentable over the allegedly obvious combination of *Makimoto* and *Bakowski*, and further in view of a paper entitled *Low-Resistance Nonalloyed Ohmic Contact to p-type GaN Using Strained InGaN Contact Layer* by Kumakura et al. (“*Kumakura*”).¹ Although claims 54, 57, 59, 60, and 84

¹ Although the Paragraph heading on page 9 of the Office Action does not list *Bakowski* in the rejection of claims 54, 57, 59, 60, and 84, the body of the rejection makes it clear that the rejection is based on the combination of *Makimoto* and *Bakowski* in further view of *Kumakura*.

have all been canceled herein, many of the limitations therein have been incorporated into independent claims 50 and 81. Regarding claims 50 and 81, Applicant respectfully traverses this rejection and submits that even if, *arguendo*, it would have been obvious to combine *Makimoto*, *Bakowski* and *Kumakura* in the allegedly obvious manner set forth in the Office Action, the resulting combination would still not teach or suggest all of the claim limitations.

The Office Action cites to *Kumakura* as allegedly teaching a p-type nitride semiconductor layer having an indium mole fraction higher than an indium mole fraction of a base layer. However, for the reasons given above regarding claims 50 and 81, applicant submits that it would not be obvious to modify *Makimoto* to have an indium-containing p-type nitride semiconductor layer in which the indium mole fraction is higher than in the base layer. As discussed above, if the indium mole fraction of a semiconductor layer formed on the base layer is higher than the indium mole fraction of the base layer, then the ohmic contact would get worse, effectively rendering *Makimoto* unsatisfactory for its intended purpose.

Pages 13-17 of the Office Action reject claims 90-98 under 35 USC § 103(a) as being unpatentable over *Makimoto* in view of *Bakowski* and further in view of *Kumakura*. Inasmuch as claims 90-95, 97, and 98 have been canceled herein, the rejection of those claims has been rendered moot and should be withdrawn. Regarding claim 96, Applicant respectfully traverses this rejection and submits that a *prima facie* case of obviousness has not been established.

Claim 96 depends from claim 81 and thus incorporates the limitations thereof. As such, applicant submits that claim 96 is distinguished over the cited art for at least the same reasons as discussed above with regard to claim 81. Accordingly, Applicant respectfully requests that the obviousness rejection with respect to claim 96 be withdrawn.

No other objections or rejections are set forth in the Office Action.

D. Conclusion

Applicant notes that this response does not discuss every reason why the claims of the present application are distinguished over the cited art. Most notably, applicant submits that many if not all of the dependent claims are independently distinguishable over the cited art. Applicant has merely submitted those arguments which it considers sufficient to clearly distinguish the claims over the cited art.

In view of the foregoing, applicant respectfully requests the Examiner's reconsideration and allowance of claims 50, 51, 53, 55, 56, 77, 78, 80-82, 85-89, and 96 as amended and presented herein.

The Commissioner is hereby authorized to charge payment of any of the following fees that may be applicable to this communication, or credit any overpayment, to Deposit Account No. 23-3178: (1) any filing fees required under 37 CFR § 1.16; (2) any patent application and reexamination processing fees under 37 CFR § 1.17; and/or (3) any post issuance fees under 37 CFR § 1.20. In addition, if any additional extension of time is required, which has not otherwise been requested, please consider this a petition therefor and charge any additional fees that may be required to Deposit Account No. 23-3178.

In the event there remains any impediment to allowance of the claims which could be clarified in a telephonic interview, the Examiner is respectfully requested to initiate such an interview with the undersigned.

Dated this 30th day of January 2009.

Respectfully submitted,

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